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ABSTRACT

Designed to contribute to planners' understanding of the state of the art and to the improvement of health manpower planning, this monograph describes and evaluates various methods used to determine present and future health manpower supply and requirements. The methodologies presented, chosen after a review of the documents identified in the Inventory of Health Manpower Planning Activities of 1973 in the Bureau of Health Manpower, are considered to be practical with regard to the resources available to state and local health planners. This first volume provides an analytical perspective, the definition of terms, the factors that determine supply and requirements, the concepts that underline each methodological approach, and the uses and limitations of health manpower statistics within the context of the subject area. A second volume is a manual that describes the methodology step-by-step. (WL)

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HRP-000 7377

Methodological Approaches For Determining Health Manpower Supply and Requirements

VOLUME I
Analytical Perspective

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Foreword

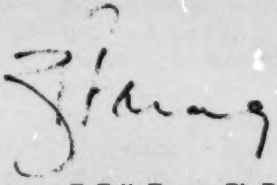
The purpose of this monograph is to describe and evaluate various methods used to determine present and future health manpower supply and requirements. The methodologies presented were chosen after a review of the documents identified in the Inventory of Health Manpower Planning Activities of 1973 in the Bureau of Health Manpower. Documents selected for their methodological content were then analyzed in detail. The authors also provided supplementary material by researching other references and information sources.

This monograph does not address the full range of methodologies that may be used in overall health manpower planning; rather, it is limited to the specific subject of estimating manpower supply and requirements. It deals only peripherally with related manpower issues that affect supply and requirements, such as labor productivity, task delegation, and geographic and specialty distribution.

The methodologies presented are practical and can be implemented with the resources available to state and local health planners. Theoretical or more complex methodologies commonly used at the national level have been deliberately excluded.

The monograph is presented in two volumes. The first volume provides an analytical perspective, the definition of terms, the factors that determine supply and requirements, the concepts that underlie each methodological approach, and the uses and limitations of health manpower statistics within the context of the subject area. The second volume is a practical manual that describes the methodology step-by-step, including questionnaire samples and selected tables for estimating health manpower supply and requirements.

It is hoped that this monograph will contribute to planners' understanding of the state of the art and to the improvement of health manpower planning.



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Preface

The National Health Planning Information Center, a component of the Division of Planning Methods and Technology, Bureau of Health Planning and Resources Development, is currently publishing two series of monographs on health planning.

The first series, of which this two-volume monograph is a part, involves health planning methods and technology. Future monographs will also include detailed descriptions of pragmatic methods developed and used by practicing health planners in a variety of locations and situations. The overall purpose is to provide health planners with suggestions for methods and procedures that can be adapted to their own health planning environment and experience.

The second series includes monographs on health planning information, as well as general and topical bibliographies of the health planning literature and reference works to current programs, to individuals, and to institutions involved in health planning.

Copies of all monographs published by the National Health Planning Information Center can be purchased from:

The National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Acknowledgments

This second monograph, *Methodological Approaches for Determining Health Manpower Supply and Requirements*, was prepared by Robert R. Nathan Associates, Inc., of Washington, D.C. The monograph is presented in two volumes, *Analytical Perspective* (Volume I) and *Practical Planning Manual* (Volume II).

The report on which this monograph is based was originally entitled "Critical Review of Methodological Approaches Used To Determine Health Manpower Supply and Requirements." The report was funded under HRA Contract No. 230-75-0067.

The project team for Robert R. Nathan Associates was directed by Harriet M. Kriesberg. The report was written by Ms. Kriesberg, John Wu, Edward D. Hollander, and Joan Bow. Advice in the preparation of the report and review of the final manuscript were provided by an outside panel of practicing health planners. The panel consisted of Irene H. Butter of the School of Public Health, University of Michigan; Lewis Dars of the New Jersey Department of Higher Education; and Thomas L. Hall of the School of Public Health, University of North Carolina.

Mary C. McGuire of the Bureau of Health Planning and Resources Development, Health

Resources Administration, DHEW, served as project officer for the contract. The entire project was under the direction of Frank A. Morrone, Jr., of the Division of Planning Methods and Technology, DHEW. Jack Lass of Aspen Systems edited and revised the final manuscript prior to publication.

The authors express their deep appreciation and gratitude to all the above-mentioned persons and especially to Hyman K. Schonfeld of the National Research Council. Mr. Schonfeld kindly volunteered to review the sections of the monograph that dealt with the health needs approach. While acknowledging their indebtedness to all of the contributors who made this monograph possible, the authors wish to assume full responsibility for any deficiencies in the contents.

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I. Introduction

Background

The passage of the National Health Planning and Resources Development Act of 1974 began a new era for health resource planning. Congress decreed that[1]:

> . . . each health system agency shall have as its primary responsibility the provision of effective health planning for its health service area of health services, manpower, and facilities which meet identified needs, reduce documented inefficiencies, and implement the health plans of the agency . . . .
>
> In providing health planning and resources development for its health service area, a health systems agency shall perform the following functions:
>
> 1. The agency shall assemble and analyze data concerning —
>
> a. the status (and its determinants) of the health of the residents of its health service area
>
> b. the status of the health care delivery system in the area and the use of that system by the residents of the area
>
> c. the effect the area's health care delivery system has on the health of the residents of the area
>
> d. the number, type, and location of the area's health resources, including health services, manpower, and facilities
>
> e. the patterns of utilization of the area's health resources, and
>
> f. the environmental and occupational exposure factors affecting immediate and long-term health conditions.

1. PL 93-641, Sec. 1513.

The specific purpose of this monograph is to help local health planners perform a critical function: the measurement of their area's manpower supply and requirements. It is intended for an audience which has no special training or expertise in statistical methods, but which has the responsibilities enumerated in the new law for health resources planning. Our objective is to present the wide range of methodologies used by health planners in assessing health manpower supply and requirements, ranging from the most simple to the more complex, but omitting the highly technical approaches that are not feasible for area planners at this time.

The manpower issues before health systems agencies today differ from those faced by planning agencies in the 1960's. These differences reflect the dramatic changes that have occurred in the system for the delivery of care in the United States in the last decade and the exciting developments on the horizon. Indicative of these changes is the rise in the nation's health bill from $26 billion in 1960 to $69 billion in 1970, as well as the growth of health services employment from 2.6 million in 1960 to 4.1 million in 1970. By 1974, 7.7 percent of our gross national product, $104 billion, was devoted to health care. Projected employment in 1975 is 5.3 million, and health services spending is expected to reach $126 billion.[2]

The burgeoning demand for health care in the last decade, whetted by Medicare, Medicaid, and the spread of private insurance coverage, produced a manpower shortage of crisis proportions in the late 1960's as the health industry's seem-

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2. U.S. Bureau of the Census. *Statistical Abstract of the United States: 1974.* Washington, D.C.: U.S. Government Printing Office, 1974; Worthington, Nancy L. "National health expenditures, 1929-74," *Social Security Bulletin,* 38 (2): February 1975; U.S. Department of Commerce, *U.S. Industrial Outlook: 1975 With Projections to 1980.* Washington, D.C.: U.S. Government Printing Office, 1974.

ingly insatiable demand for more manpower ran into the barrier of a limited supply. The shortage persisted despite a tremendous increase in health personnel. From 1960 to 1970, while U.S. population increased 18 percent; the number of doctors grew 21 percent; registered nurses, 33 percent; radiologic technicians and technologists, 32 percent; nurses' aides, orderlies and attendants, 78 percent; and dental hygienists, 173 percent.[3]

By the early 1970's there were signs that manpower needs were beginning to stabilize and even to decline. Although shortages continue to exist in some areas, there are areas and occupations with a surplus of manpower, and some health graduates have experienced difficulty finding jobs. The Committee on Economic Development in its 1973 proposal for a national health care system pointed out that:

> Poor distribution, together with inadequate utilization, training, and organization, have aggravated the shortages of manpower in some areas while causing surpluses in others. Beyond some crude and increasingly doubtful ratios of professionals to population, it is not even known how many people are now needed, let alone how many would be needed under a better-organized system.[4]

Different diagnoses call for different remedies. If (as is apparently true) the manpower problems we face today are closely tied to maldistribution and malutilization, we must try prescriptions to counteract these difficulties that differ from the treatment we would use to overcome general shortages. The need for precise, accurate and timely manpower data to assess correctly the situation has never been more pressing, and the

---

3. Goldstein, Harold M. and Horowitz, Morris A. *Research and Development in the Utilization of Medical Manpower.* Boston: Center for Medical Manpower Studies, Northeastern University, 1974.

4. Committee on Economic Development, "Building a national health care system," April 1973, p. 33, quoted in Goldstein and Horowitz, *op. cit.*

importance of methodologies for making reliable projections to plan properly for the future has never been more acute.

The data base for adequate health manpower planning does not exist and needs to be built. Some of the published data on supply and requirements are best described as "guesstimates" and are of questionable value. The inadequacies of current statistics are compounded by shortcomings of data related to region and locality, occupation and specialty, length of required education or training, type of employment situation, demographic characteristics, salary, and so on.

In addition to the problems generated by an insufficiency of data, difficulties arise in the selection of an appropriate methodology for determining present estimates and future projections. The issue being addressed and the underlying concepts dictate both the data requirements and estimating methodology. How an estimate is made depends on the available data, and the available data determine the choice of methodology. No methodological approach is universally applicable; each planner must weigh the alternatives and select the methodology or mix of methodologies appropriate for his purposes and suitable for his data.

A planner's choice is not made in a vacuum, but in the particular political and organizational setting in which he operates. The environment of each planner is *sui generis*. In each locale, however, disparate forces, varying from health providers and educational institutions, professional associations and labor unions to courts and insurance companies, are present and impact on the production, distribution and utilization of health manpower. The planner's goal in preparing estimates of supply and requirements is to make a rational, effective contribution to policy decisions. For his findings to influence policy, the methodology he uses should be comprehensible and persuasive to policy-makers in his area.

II. Definition of Terms

Definitions Affect Estimates

However we approach the methodology for determining "health manpower supply and requirements," we must begin with precise definitions of every term in the phrase, since we must know exactly *what* we are proposing to measure, as well as *how* we propose to measure it.

"Health manpower" in its most broad definition applies to more than six million persons in the health care industries, engaged in any capacity in activities devoted to providing health care: employees and self-employed; the public and private sectors; those engaged in patient care, in ancillary health services, and in administrative and supportive activities. Although such a broad definition is useful in measuring and planning the total impact of the health care sector in the allocation of national resources, many occupations are included in it which are beyond the concern of health resources planning (for example, in maintenance, laundry, food preparation, computer operation). On the other hand, other definitions may be too narrow for our purpose: they may include only the private sector, to the exclusion of the public; or only employees, to the exclusion of the self-employed. Thus, in using any statistics of "health manpower," it is necessary to take careful note of the definitions and coverage, down to the fine print and the footnotes, since these will greatly affect the results of the analysis.

Information needs are defined by the planning purposes to be served; and for the purposes of health resources planning, the most useful information is that concerning occupations or clusters of related occupations, of persons qualified to perform professional or technical services in providing health care directly or indirectly to individuals or groups of people. The occupation is the common unit for organization, delivery of services, training, credentialing, employment, compensation, etc., and therefore an appropriate unit for manpower planning.

We must also be precise in defining "occupations" or "occupation clusters." "Occupations" are typically defined by a set of functions, requiring a specific combination of knowledge and abilities, and are usually associated with a specific title (for example, "registered nurse" or "respiratory therapist"). Title alone is not a sufficient identification of an occupation, since the same set of functions may be called by different titles (e.g., "radiologic technician" or "X-ray technician"); and the same title may be applied to several distinct occupations (e.g., "nurses" may be registered nurses, licensed practical nurses, or nonlicensed practical nurses). Thus, unless occupations are defined specifically, estimates of requirements and supply are misleading.

Sometimes the focus of the manpower planning is on an alleged or prospective "shortage," and here again we must take care that the term is precisely defined. "Shortage," of course, exists when "supply" is less than "demand," but there have been many instances of reported "shortages" coexisting with unemployment in the same occupation — either because the supply was narrowly defined to exclude qualified persons who might be available, or because the demand was broadly defined to include requirements for health manpower in excess of the means to pay personnel to fill them. Thus, the definitions of manpower "requirements," "demand" and "supply" are central to manpower planning.

Concepts of Requirements for Manpower

Derivation of Manpower Requirements

As used here, the term "manpower requirements" is defined as the manpower necessary to provide health services to a population. The magnitude and composition of the requirements are specific not only to the population in question, but also to the level, intensity and quality of the health services, and to the delivery system and the modes of manpower utilization prevailing or assumed to prevail at a given time and place. Therefore, manpower requirements are derived from these characteristics of the health care system. This does not mean that we must always estimate the use of health care services before we can estimate manpower requirements; as we shall see, short cuts may be used at times to estimate manpower needs directly. In view, however, of the derived nature of manpower requirements, we must explicitly take into account anything that affects the level and quality of the services to be provided (e.g., health insurance), since it will also affect manpower requirements.

Concepts of Demand and Demand Elasticity

"Demand" is an economic term. It refers to the quantities of goods or services which users are willing to buy at various prices. Demand for manpower (labor) refers to the amount of manpower of specific kinds (in specific occupations) which consumers or employers will use (employ) at various rates of compensation (wages, salaries, or fees). In general, the lower the price, the greater the demand and vice versa. Thus, the demand for manpower is expressed in the employment (or self-employment) for pay of personnel who produce goods or provide services which people wish to buy at specific prices. Demand for health manpower is derived from the demand for health care services and from consumers' willingness and ability to pay for those services; it is expressed in the employment and compensation of personnel to provide the services. This is what economists call "effective demand" — the use of money to purchase goods and services to satisfy needs or

wants. The money, and the willingness to use it for these purposes, make demand "effective."

Needs can be converted to effective demand in many ways. When people have more money income, they spend more on health services. [1] (This is what we mean when we say that "the demand for health care is income-elastic.") Similarly, when the price paid directly by individual consumers for health services declines (for example, through health insurance), people at any given income level tend to use more health services than they would at higher prices; and the total expenditures for services are greater. [2] Finally, needs can be converted to demand by the intervention of a third party (government or philanthropy) to pay (in whole or in part) the provider of the needed services on behalf of the consumer.

For the past 25 years, and particularly for the past decade, all of these influences have been at work: rising family incomes; the spread of health insurance, including Medicare; and the various public subsidies for health care to individuals, such as Medicaid, and for health care facilities, principally hospitals. The result has been an explosive increase in expenditures for health care and a narrowing of the gap between needs and effective demand. These trends must be explicitly taken into account in projections of demand for health care services and the derived demand for health manpower.

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1 Rosett, R. and Huang, Lien-fu. *The Effect of Health Insurance on the Demand for Medical Care.* Rochester, N.Y.: University of Rochester, 1971. See, for example, table 2.

2. *Ibid.* Also, U.S. Department of Health, Education, and Welfare, Social Security Administration. *A Report on the Results of the Study of Methods of Reimbursement for Physicians' Services Under Medicare.* SS Pub. No. 92-73 (10-73). Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1973, Vol. II, part II, table 21. Note that the increase in demand for insured services occurs when consumers individually pay less directly, even though they are paying more in the rising costs of the insurance.

Concepts of Need

When we speak of "need" we refer to some level of health services that ought to be consumed during a period of time in order to attain a desired health status, determined according to some professional standard in the light of existing medical knowledge as well as the health manpower to provide these services. Since need, both for services and manpower, is determined without regard to price and effective demand, its use in health resources planning emphasizes the gaps in health services and facilities for which resources should be sought in order to bring the health care for a specified population to the standard considered to be minimum or optimum. In this respect, the concept of need is associated with an earlier stage of planning than the concept of effective demand, which presupposes facilities and services in being (or in prospect, with funding assured), and is concerned with planning their operations, including their manpower resources.

Needs may be formulated in terms of observed gaps in available health services or in terms of standards of health care that are not being met. If sick people are not being adequately cared for, or if defects of eyes, ears or teeth among children are not being detected or corrected, obviously there are needs for health services and for personnel to provide them. In these cases, there are by definition "shortages" of health services. Medical professionals may determine needs on the basis of their judgments of what is required to provide a satisfactory level of health care, given the state-of-the-art. But just as hungry people or nutritionists' findings do not create market demand for food until there is money to buy it, so poor health does not create a demand for health services (and the derived demand for health manpower) until there is money for the operation of facilities and the employment of personnel. As one study commented:

> Perhaps more in health than in any other service industry, "need" and "demand" are clouded and confused by interest groups'

biases. A given area might have a well-documented need for, say, five physical therapists, but as long as the money is not available to fund these positions, there is no demand.

DEMAND. The number of jobs that can be financed with current or future funds.

NEED. The number of persons in a field who will be required to produce a given level or amount of service judged to be desirable.

The distinction is between social ideals (what people feel ought to be done) and economic realities (what people are able to pay for).[3]

Concepts of Supply and Supply Elasticity

The definitions of supply of manpower in an occupation are even more numerous than the definitions of demand. "Supply" may be variously defined as:

1. The number of persons in the specified area qualified to practice the occupation, whether actively practicing or not

2. The number available to practice the occupation at a given time, including those employed (or self-employed) and those unemployed (available for work but not employed)

3. The number of unemployed

4. The number of entrants — the newly qualified practitioners entering the market, and the previously qualified practitioners re-

---

3. Connecticut Institute for Health Manpower Resources, *Not by Numbers Alone: Study of Educational Programs and Employment Opportunities in Health in Connecticut and the Northeast.* Hartford, Conn.: The Connecticut Institute for Health Manpower Resources, January 1974. For further discussion of the implications of the different concepts, see Dars, Lewis. *An Analysis of the Concepts of Demand and Need for Medical Care and Their Implications for Manpower Planning.* Health Manpower Planning Series, Monograph 1. Trenton, N.J.: Department of Higher Education, 1973. See also, Jeffers, James R., Bognanno, Mario F. and Bartlett, John C., "On the demand versus need for medical services and the concept of 'shortages'," *American Journal of Public Health,* 46-63, January 1971.

entering the market after a period of non-availability

5. The numbers who would be in the market if the pay (or other form of compensation) were raised by specified amounts above specified prevailing levels.

All of these definitions are "correct," and each has its uses in connection with a specific planning operation and time frame. The important points are that the definition chosen should be explicitly suited to the operational situation to which it is applied, and that it should be compatible with the definition of demand used in the same situation. In addition, because part-time work is an accepted practice in many health fields, the number of persons referred to in the definition should relate to full-time equivalent personnel.

The last definition (item 5 above), which describes the relationship between supply and compensation, is the most rigorous economic concept of supply and the most difficult to measure and apply. It recognizes that supply is not a fixed quantity or a static element in the labor market but responds to economic (and other) incentives, more or less depending on the occupation, the training facilities and training time, and the characteristics of the potential supply. The more responsive the supply to the various incentives, the greater the "supply elasticity" is said to be. For example, a substantial increase in salaries offered to nurses may produce an almost immediate inflow of nurses already trained but inactive; an increase in compensation to physicians, however, will have a delayed effect in inducing physicians to move from one area to another, or an even longer delayed effect (as long as a decade) while medical education institutions are expanded to train additional physicians. The supply of nurses is much more elastic than the supply of physicians, and the supplies of allied health professionals requiring one or two years of training are more elastic still.

The use of other definitions of supply depends on the planning problem at hand. If the opening of a new hospital is being considered, it is necessary to know whether the unemployed reserve plus the new entrants and re-entrants in the various occupations will be sufficient to fill the budgeted slots. If the choice is between establishing a training program for allied health occupations or undertaking a sustained recruitment campaign, it is necessary to measure the potential supply of qualified persons and the incentives which would be required to activate them.

Thus, the relevant concept of supply in large part determines the choice of methodology. Whether information is sought from employers, from labor force statistics, from licensing or registry rosters, or from education and training institutions depends on the aspect and definition of supply that is relevant to the planning problems.

Concept of the Relevant Labor Market

A geographic labor market may be defined simply as "the area within which workers compete for jobs and employers compete for workers." [4] Typically, labor markets are local, encompassing an area in which workers can change jobs without having to change residence. However, Americans are traditionally mobile, and moving from place to place in search of job opportunities is common; also, for some occupations, labor markets may be regional or national. Especially in the professions, young men and women often move about as they obtain their professional education and training; they are, therefore, at least at the time they complete their training, relatively unsettled and free to decide where to settle for the most promising opportunities. Nevertheless, for manpower planning purposes, occupational labor markets are

4. U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Supply: Concepts and Sources of Data for Manpower Analysis*, BLS Bulletin 1816 (Washington, D.C.: U.S. Government Printing Office, 1974).

essentially local, limited by the distance over which commuting is possible.

The larger and denser the population of the local area, the more likely it is that there will be demand, supply, and an active market for most of the health care occupations. This is particularly true of the 265 metropolitan areas in which nearly three-fourths of Americans live and work. The size of these areas generates effective demand for most kinds of health care services; this demand in turn offers opportunities for livelihood for a wide variety of generalists and specialists in medical, dental, nursing and allied health occupations. Consequently, metropolitan areas have attracted a more than proportionate number of health professionals. Thus, in most cases, metropolitan areas can be considered relevant labor market areas for most purposes of health manpower planning. Moreover, many of the kinds of statistics useful in planning are available for "standard metropolitan statistical areas."

Since the relevant labor market encompasses the area from which resources are drawn, the geographic boundaries for non-metropolitan labor market areas are set by the search for qualified personnel or by the location of educational institutions that train them. Non-metropolitan areas may not, in fact, contain supplies of health care personnel sufficient even for their limited health facilities. Consequently, the salaries offered may have to be adjusted upward, depending on the elasticity of supply, to attract manpower into these areas.

Concept of Appropriate Health Service Area

The National Health Planning and Resources Development Act of 1974 (P.L. 93-641) requires establishment of health service areas, which it defines as:

> . . . a geographic region appropriate for the effective planning and development of health services, determined on the basis of factors including population and the availability of resources to provide all necessary health ser-

> vices for residents of the area.... To the extent practicable, the area shall include at least one center for the provision of highly specialized health services.[5]

The Act provides further that the area (except in unusual circumstances) shall have a population between 500,000 and three million, with emphasis on SMSA's but with due regard to the differences in health planning and services between metropolitan and non-metropolitan areas. These requirements of law explicitly recognize the nature of health service areas and their relation to labor market areas and economic areas generally. Like the health services from which it is derived, the demand for labor tends to be more diversified and more specialized as we progress from the sparsely populated areas to the most populous and richest communities, while by the same token the labor supplies in the larger populations are more plentiful, diverse, and specialized, and the training facilities more accessible. Labor market areas and health service areas will tend to be compatible as sources of information and as units of analysis for health manpower planning.

Importance of the Assumptions in Planning Outcomes

Projections are measurably influenced by the underlying assumptions. The validity of the future estimates depends upon the extent to which their underlying assumptions realistically anticipate the changes that the future will bring.

Different estimates follow from different concepts of what is being measured and from different ideas of what changes and rate of change will occur in the future. With regard to the supply of health occupations, for example, government support for academic institutions, especially medical and allied health programs, in the years ahead is vitally important. The assumptions made about the level of government support are key

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5. U.S., *National Health Planning and Resources Development Act of 1974 (P.L. 93-641)*, Sec. 1511 (a).

determinants of the size of the graduating class and thus of the estimate of future increments of supply. For example, the Federal Government's projections of health manpower supply are premised on:

> . . . one critical set of assumptions . . . that the health manpower production system will receive the future support from Federal or other sources that is needed for the maintenance and operation of the system at its assumed 1974-75 capacity level. Implicit in the assumption is that the effect on the health manpower production system of the late-1972 levels of Federal biological research and supoort programs will not change significantly in the years ahead, and that the effects of military and Public Health Service recruitments and needs will remain roughly as they are today.[6]

With regard to requirements, the key determinants are the number of people requiring care and the amount of money available to pay for it. Assumptions about population characteristics, the general economy, income levels, consumer expenditure patterns, and government policy regarding health care financing underlie the projections of the demand for health care. The manpower required to provide the projected level of care is conditioned by the form of the delivery systems, the state of technology, labor productivity and so on.

Since a predominant proportion of health workers are women, assumptions about labor force participation rates and the lifetime career activity pattern of women are important to the future supply and requirement estimates.

As one moves further in time from the present, one's assumptions are inevitably subject to more uncertainty. For this reason, it is advisable to

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6. U.S. Department of Health, Education, and Welfare, Bureau of Health Resources and Development, *The Supply of Health Manpower: 1970 Profiles and Projections to 1990*, DHEW Pub. No. (HRA) 75-38. Washington, D.C.: U.S. Government Printing Office, 1974.

prepare more than one projection based on different sets of assumptions, ranging from the most conservative to the most conjectural among plausible alternatives. The use of different sets of assumptions provides a test of the sensitivity of the estimates. If a change in assumptions does not affect the final estimate substantially, one can have more confidence in the projection.

III. Factors Affecting Demand and Supply for Health Manpower

Determinants of Demand

The demand for health manpower is determined by (1) the quantity and quality of health services demanded, which are conditioned by such factors as the population served, prices and incomes, and the supply of health services available; and (2) the productivity (output of services per person) of health manpower, which is specific to the state of medical technology and to the health services delivery system. Demand for manpower is thus influenced by many factors.

The Population Served

The size, the growth, and the characteristics of the population are basic determinants of demand for health services and therefore of health manpower. Health resources planning must take account not only of the numbers of people and the rates of increase or decrease, but of the birth and death rates, the proportions of the very young and the very old, the ethnic composition (since some diseases are endemic to certain ethnic groups), and the urban-rural composition. For example:

> The health industry was one of the first to be affected by the decline in births . . . . This decline undoubtedly permitted a shift of hospital paramedical staff to other urgent and

> growing needs and may have already influenced some doctors and nurses to choose specialties other than obstetrics or pediatrics . . . . Assuming maintenance of the two-child family average and the continued validity of the doctor-patient ratio currently estimated by the Department of Health, Education, and Welfare, the need for physicians in the year 2000 will be fewer than the number needed to service a population increasing at the higher growth rate (the three-child norm). Demand for other health personnel will be similarly affected.[1]

Economic Factors

Demand is strongly influenced by consumers' incomes (expenditures for health services rise faster than income rises) and by the prices of health services (the lower the price, the greater the utilization). The income elasticity and price elasticity of demand have been the principal factors in the sharp increase in demand over the past decade, as family incomes have risen and health insurance has lowered the effective prices of health care services, principally those of hospitals and physicians. Estimates and projections of demand for health care and for the manpower to provide it must take explicit account of the incomes of the population for whom the services are intended and of the insurance coverage of the services among that population: for example, families with young children are likely to have more income and less insurance coverage than the elderly; industrial workers are likely to have higher incomes and more insurance than farm workers; etc.

Productivity

Given the demand for health care services on a given scale, the question arises: How many people in what occupations are required to fill the demand? The answer obviously depends on the

1. U.S. Department of Labor, Manpower Administration, *Manpower Report of the President, 1973*. Washington, D.C.: U.S. Government Printing Office, p. 78, 1973.

output per person — or productivity, as it is called.[2] For our purposes here, *output* is defined as units of service (visits to the doctor, days of routine hospital care, surgical procedures, dental procedures, laboratory tests, X-rays, etc.). Numbers of personnel (full-time equivalent) of various kinds required to perform specified numbers of these service "outputs" are the "*inputs*" which determine measures of productivity: X-rays per day (or month, or year) of radiologic technician time; "well-baby" clinic visits per pediatrician-day; patient-day of routine nursing service per RN-day; etc. The variety and complexity of health care services are such that it is often difficult and sometimes impossible to identify homogenous classes of service outputs with defined occupational personnel inputs. Yet it is unmistakable that there are significant differences among health care facilities depending on their modes of delivery (e.g., inpatient vs. outpatient), types of service (e.g., acute care hospitals vs. skilled nursing homes), standards of service, etc., and that these differences are valid and useful in planning health manpower resources. Similarly, among facilities of the same types, productivity differs between

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2. The problem of measuring productivity in health services is complicated by theoretical ambiguity of concept and definition. If the "output" is maintenance of a given state of health of a population, then health services are "inputs." So far, satisfactory measures of "a state of health" have not been developed. On the other hand, "outputs" can be defined and measured as the services performed by health care personnel, and the numbers and mix of personnel are "inputs." The latter definition is used here because it is compatible with other elements of the system for planning the development and allocation of health resources.

Still another concept is ". . . a synthesis of the two already discussed. This is a definition in terms of episodes of illness appropriately cared for . . . using the hospital 'case' rather than patient-day as the unit of output . . . relating service to some health objective . . . ." ("Issues in the measurement of productivity," (in) Donabedian, Avedis. *Aspects of Medical Care Administration: Specifying Requirements for Health Care.* Cambridge, Mass.: Harvard University Press, 1973.)

the more — as compared with the less — efficiently organized and managed.

A line of research in "task analysis" in recent years has begun to provide systematic information on the tasks which are the basic component "building blocks" of health care services. [3] This information points the way to the organization of tasks and personnel for the most efficient assignment of work and the delegation of tasks according to the knowledge, skill and training they require so that highly skilled personnel are not used for tasks that can be satisfactorily performed by those less highly trained. In this way progress can be made toward defining standards of productivity; toward utilizing most efficiently scarce, skilled personnel; toward achieving better service; and toward effecting lower costs.

The State-of-the-Art of Health Care

The technology of medicine and dentistry affects both the demand for health care services and the manpower required to provide them. Obviously, technology determines what services can be offered: the development of diagnostic and therapeutic procedures creates a demand for them. One has only to reflect on the limited scope of medicine and dentistry at the beginning of the 20th century to realize how scientific discoveries and technologies have enlarged demand. The process is apparently without end. Technology influences the tasks that manpower performs and the skills that must be acquired.

The advance of technology also increases the efficiency and productivity of health care personnel and permits services to be provided by fewer, and often more specialized, personnel. For

3. For an overview of this approach, see U.S. Department of Labor, Manpower Administration, *Job Analysis for Human Resource Management: A Review of Selected Research and Development*, Manpower Research Monograph No. 36. Prepared by Michael Wilson. Washington, D.C.: U.S. Government Printing Office, 1974; especially pp. 18-19, 26 and 28, 29-34, 39, and appendices A and B.

example, while biochemistry has greatly increased the types of laboratory tests and their uses in diagnosis, the development of such sophisticated equipment as the autoanalyzer has made it possible for a technician to perform many tests on a blood sample more speedily and at relatively lower cost than formerly. Thus technology on the one hand increases the demand for health services and the requirements for health manpower, and on the other hand, raises productivity and thereby reduces the number of persons required. Technological change, by altering the demand for services, the tasks performed and the output per worker, creates or eliminates health jobs, increasing or decreasing manpower requirements.

The Characteristics of the Delivery System

The system for the delivery of health care services is composed of the facilities, the personnel, and their relationships to patients, in the organization, administration and financing of health care services. Delivery of physicians' services on a fee-for-service basis through the offices of individual physicians differs in important ways from delivery through the outpatient department of a hospital or the clinic of a prepaid group or other HMO, and these differences influence not only the demand for services of various kinds but the number and occupational mix of the personnel providing them.[4] Shifts in the utilization of services between, for example, inpatient and outpatient care, or between treatment and prevention of illness, produce corresponding shifts in demand for health service personnel. In fact, the

4. For examples of effects of various national health insurance plans on manpower demands, see U.S. Department of Health, Education and Welfare, *Assessment and Evaluation of the Impact of Archetypal National Health Insurance Plans on U.S. Health Manpower Requirements*. Prepared by Huang, Lien-fu and Shomo, Elwood (Robert R. Nathan Associates). DHEW Pub. No. (HRA) 75-1. Rockville, Md.: U.S. Department of Health, Education, and Welfare, 1974.

explosion of demand and cost since 1965, and the prospects for further extension of health insurance have stimulated variations in delivery systems in the search for cost-containment measures. Consequently, health resources planning should take account explicitly of the changes in the delivery system impending or prospective at the time the planning is done.

The Supply of Health Services

Health care is one of the sectors of the economy in which supply is an important determinant of demand. Effective demand presupposes a supply of facilities and personnel; demand can be effective only if there are services to be purchased and providers from whom to purchase them. Moreover, the availability of health services as the consequence of the discovery and application of new medical and dental technology in itself generates a demand, as we have seen again and again. This is particularly true with the proliferation of specialized services. In the face of the consumer's imperfect knowledge, the physician or dentist becomes the professional adviser or even the decisionmaker: "Once the consumer has placed himself in the physician's hands, the physician plays a major role in deciding the amount of service consumed." [5]

The influence of supply on demand is nowhere clearer than in health resources planning. Whenever services are limited by the unavailability of facilities or personnel (e.g., inadequate hospital capacity or lack of the full range of medical/dental capabilities), as may be the case in rural or remote areas — villages in Alaska are extreme examples — the demand is truncated accordingly. Planning the expansion of the supply of services must take account explicitly of the effective demand for ser-

5. *Report of the National Advisory Commission on Health Manpower.* Washington, D.C.: U.S. Government Printing Office. Vol. II, 238, November 1967.

vices and personnel which will be activated by the supply.

Relative Importance of Determinants of Demand

Although all demand for health manpower is derived from demand for health services, the several determinants of demand affect different occupations differently. Some occupations (e.g., physicians and dentists) are linked primarily to size and distribution of population; others (e.g., pediatricians) are linked to birth rates. The demand for laboratory technicians, on the other hand, is strongly influenced by the development of biochemical technology and equipment. For purposes of manpower resources planning, it is important to recognize the specific dominant influences on the demand for manpower at different points in the delivery system.

While the demands for "free-standing," autonomous professionals — like physicians and dentists — may derive in the first instance from exogenous variables of population and income, demands in other health care occupations are strongly affected by the number of physicians and dentists and other aspects of the delivery system. The demand for nurses, for example, derives from the facilities in which nurses are employed, such as physicians' offices, hospitals, clinics and nursing homes; and from such secondary determinants as school health programs and the number of children in school, and nurse training programs and the requirements for nurse instructors. The demand for pharmacists, on the other hand, is determined by the number of prescriptions written — which itself is affected by the development of drug therapy (the drugs available for treating patients and the physicians' propensity to use them) — and the productivity of pharmacists (largely a result of the extent of pre-compounding in manufacture).[6]

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6. Maryland Council for Higher Education, *A Projection of Maryland's Health Manpower Needs Through the 1980's*. Baltimore, Md.: Maryland Council for Higher Education, 1969.

Medical, dental, nursing and allied health occupations seldom occur in isolation, unrelated to one another. Depending on the relationship of demand and supply and on the delivery system, tasks may be reallocated or delegated between occupations functionally related in the delivery process though of different skill levels; e.g., MD and RN, or RN and LPN. Thus, the demand for RN's may be determined in part by a deficiency in the supply of MD's. The reallocation of tasks may go the other way, as well: an abundance of RN's can limit the demand for LPN's.

In sum, there are no neat formulas for deriving demand for health care occupations mechanistically from the various determinants. Not only every community, but every occupation as well, must be analyzed with intelligent regard to the peculiar circumstances of the times, arising as they do from determinants as diverse as birth rates, health insurance, facility construction programs, or technological developments.

Determinants of Supply of Health Manpower

Over the long range of time and place, supply of health care manpower will be determined, like supplies in other occupations, by underlying economic and institutional factors: rates of pay and earnings expectations in relation to time and cost of training; working conditions, rewards of status and other intangibles; opportunities for training and for employment; geographic and occupational mobility; institutional incentives and constraints that encourage, discourage, or circumscribe occupational practice. Because of the public interest in health care, health service occupations are subject to these long-term influences more than most: training is relatively prolonged and exacting; opportunities are institutionally determined; credentialing as a prerequisite to employment is widespread; and occupational and class distinctions are more persistent than in most fields. On the other hand, earnings in many health service occupations are good or better than good, prestige is high, and the prospect of a

career in the medical and healing arts is persistently attractive to young men and women.

Education and Training Programs

In many medical, dental, nursing and allied health occupations the flow of qualified personnel into the labor supply is governed by the training system: the capacity of training facilities and programs, the length of training and its costs, the number of applicants, the standards for admission, the number of students in each class, the dropout rate during training, and the number of graduates. The health resources planner needs to pay close attention to the admissions policies and practices of local and regional health education and training institutions: How many are admitted? What are the qualifications for admission? What are attrition rates between admission and graduation?

In the case of physicians, medical education is prolonged and costly, and the number of places in medical schools is limited and requires years (and a great deal of money) to expand. Because medical school facilities expanded so little for so many years, the supply of American-trained physicians has been inadequate to national requirements, with the result that the U.S. supply has been (and is being) augmented by large numbers of foreign-born, foreign-trained physicians. Thus, the additions to supply are governed by the capacity of medical schools and the admission of immigrant physicians. The supply of dentists is similarly governed, though the time and cost of training are less. But the shortage of dentists is masked by dental neglect, because effective demand (what consumers will pay for) falls far short of the dental needs of the population in the absence of insurance coverage.

Locational and Occupational Decisions of Qualified Personnel

The planner must assess the extent to which those who are graduates of local and regional training institutions become part of the local and regional supply. Nurses and allied health workers,

for example, are more likely to remain in the area in which they are trained than are doctors. In general, the more highly trained the occupation, the wider the relevant labor market and the greater the geographic mobility among its practitioners. Physicians tend to move, sometimes over considerable distances, in search of opportunities to pursue their specialties, to have access to well-equipped, well-staffed hospitals, and to enlarge their earning possibilities. The markets for radiologic and laboratory technicians, on the other hand, tend to be more strictly local.

The movement of personnel at all professional levels both in and out of the area reflects, in part, the fact that Americans are mobile people; in any given year about one American in 16 moves to a different state. In the case of health service professionals, the movement has been unbalanced as physicians, dentists, nurses, and other highly trained personnel have gravitated to larger communities and especially to metropolitan areas, drawn by opportunities for more specialized practice, higher earnings, and an atmosphere conducive to professional development. The obverse is that many smaller communities and rural areas are undermanned. This is another example of the perverse economics of the health services sector: the concentration of health manpower supplies in metropolitan areas has not restrained the prices of health services, nor has the paucity of supply in small communities served to raise them.

The number of graduates of local and regional training programs, therefore, is not synonymous with the number available to the local or regional supply. Not only do graduates leave the area (to return to their homes elsewhere or to seek more favorable opportunities), but some even leave the occupation, perhaps because they find they can earn more in some other field. In any event, to estimate local supply it is necessary to discount the number of graduates on the basis of past experience, especially in the occupations with relatively short training where the personal investment in time and money is not so great.

Labor Force Participation Rates

Although the output of education and training institutions is the principal determinant of the supply of new practitioners in health service occupations, much the largest part of the supply at any time is composed of previously trained personnel, either those employed, unemployed, or out of the active labor market for personal reasons. Because rates of participation by women in the active labor force vary from time to time according to their personal circumstances and preferences, "potential supply" is likely to be significant in occupations heavily populated by women. For example, women 18 to 25 and women 35 to 55 years old have higher labor force participation rates than those 25 to 35. Women with pre-school children are only two-thirds as likely to be in the labor force as those with children of school age. Women are more than five times as likely as men to be working in part-time jobs. These participation rates all reflect ways in which women adapt to the competing demands on them which arise from their several roles. They are particularly applicable to health service occupations because women are so prominent a part of the labor force in these occupations, especially in nursing, which is almost entirely staffed by women. It is not unusual for young women to work until the birth of the first child and to leave the labor force or to work part-time for a few years, returning to full-time employment in their middle or late thirties. These withdrawals and re-entries must be reckoned in estimating supply. They reflect a pattern of lifetime career activity that is undergoing change as women's role in society is being redefined.

Licensing and Certification

For many occupations some form of credentialing is practiced — either licensing by the state as a prerequisite to practice or certification by a professional organization attesting to the completion of accredited education or training necessary to establish the qualifications of individuals. Credentialing requirements may constrain the supply

of manpower in any locale by limiting the number eligible for employment and by preventing more efficient utilization of manpower. A significant source of future supply may develop from the use of proficiency examinations as a basis for credentialing, as mandated by the 1972 Social Security Amendments, as an alternative to the completion of prescribed, accredited education.

Rates of Pay and Earnings Expectation

Because physicians and dentists are among the best paid occupations, qualified applicants exceed the limited number of places in professional schools, despite the long, difficult and expensive training. The high returns have attracted relatively large numbers of foreign medical graduates, who (as noted above) in recent years have numbered nearly as many annually as U.S. graduates. There is no doubt that many more American men and women will enter the medical professions as places are made for them.

There is a wide gap in earnings between physicians and dentists and all other health service occupations. Nurses in particular have been underpaid relative to comparable professionals in other fields, and this fact has been reflected in shortages from time to time. The increased demand for hospital nurses resulting from hospital insurance brought about improvements in pay and work conditions for nurses and an increased supply of nursing students and graduates. In addition to long-run responses of this kind, it is often possible in the short run to draw nurses from the potential supply by offering higher pay as well as hours of work compatible with their preferences.

Rate of Deaths and Retirements

Death and/or permanent retirement of part of the labor force each year are factors which also lower supply. It is estimated that on the average, death and retirement annually remove about two percent of the male labor force and about five percent of the female labor force. Estimates of annual rates of separation for all causes by

individual occupation for each state are published by the U.S. Department of Labor and should be explicitly used in projecting net changes in the supply.[7]

Relative Importance o Determinants of Supp

The relative importance of the several determinants of supply is specific to the various occupations, the sources of supply, and the means of generating supply. Among health service occupations requiring significant training, the capacity of the education/training facilities is the overall long-range constraint. The supply of applicants is ample and in most occupations exceeds the number of places in the schools. The capacity of the schools is not a static constraint, since places can be made for more students; but the lags between new capacity and output of health professionals may range from several to 11 years (the latter in the case of physicians).

For the supply of physicians the rate of immigration of foreign-trained doctors can be almost as important as the capacity of U.S. medical schools, as well as the only possible short-run adjustment to supply, especially for resident staffs of hospitals.

For RN's also, immigration has been a significant factor when there was an apparent shortage of nurses. The expansion of nurse training capacity, however, has lessened the dependence on foreign-trained nurses. Among nurses, nevertheless, the qualified but inactive segment provides a source of potential supply, part of which may be responsive to recruitment offering terms of employment, pay and working conditions calculated to attract nurses back into active status.[8]

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7. See the detailed description of the use of labor force separation rates for estimating outflows due to death and retirement in Part II of this monograph.

8. A major metropolitan hospital recently disclosed that it was having trouble recruiting staff nurses because it did not know that it was paying below the market.

Since health services are essentially local, questions of supply of personnel (or services) will ordinarily focus on the local (or regional) labor market and on the factors which determine the supplies which are (or will be) available to that market. In major metropolitan areas, supplies in most health service occupations are likely to be determined locally for the most part by the outputs of local training institutions, adjusted by the flows of persons to areas of greater opportunity and away from areas of less opportunity. These flows are not automatic, however, and manpower planning may be itself a determinant of supply insofar as it stimulates recruitment efforts. Less populous areas, on the other hand, may encounter shortages even when national supplies are adequate and may have to compete vigorously with metropolitan centers for the output of trainees.

For physicians and dentists, both U.S. and foreign trained, the relevant labor market is wider. Immigrants are often recruited for resident staff by the less well-known hospitals, and — if they are able to meet licensing requirements and remain in the United States — may be more mobile and available to smaller communities. Those trained in the United States have a choice of practicing in their home communities, in the places where they intern, or in markets which offer attractive prospects of earnings, specialization and professional opportunities. Even in large communities it is difficult to anticipate which determinants of supply will dominate; in smaller communities it is much more difficult.

The Interaction of Demand and Supply

We have noted earlier the tendency in health services for supply to generate demand, for consumers to avail themselves of services that appear likely to be conducive to health and comfort. This is most clearly illustrated by the resort to new modes of surgery and chemotherapy, which find a ready or even avid market when they become available. From this we may conclude that in a relatively affluent society with a large component of income, both private and public, to be

used for discretionary spending (that is, for consumption other than food and shelter), there is latent demand for more health care than is available, and that the appearance of a doctor or a hospital or a mode of treatment where there was none before activates this demand. Technical and biochemical advances — a new drug or a new piece of equipment — thus change the demand both for health care and for the numbers and qualifications of the manpower to deliver it. The changes in the manpower demands, in turn, affect the institutions and programs for education and training.

There is also an interaction of demand and supply in health services manpower. A half century ago, when the effective demand for health care was limited by the relatively low level of personal incomes, the supply of physicians was greater than the demand could employ efficiently, with the result that physicians were underutilized and performed many health service tasks now performed by allied health personnel. Under conditions of shortage, on the other hand, tasks are delegated from scarcer to more plentiful classes of manpower, e.g., from physicians to nurses. In the same way, an inadequate supply of RN's stimulates a demand for practical nurses.

Though they may originate as adaptations to immediate demand-supply situations, these changes, once they are initiated, may become embedded in conditions of productivity, pay and occupational scope. The use of health service personnel at their highest skills increases their productivity and lays an economic basis for increases in pay. As these conditions become more widespread, they are reflected in tables of organization in hospitals and in the programs of training institutions. The continuous chain of interactions between demand and supply should be explicitly recognized in manpower resources planning, and its effects should be anticipated in demand and supply projections.

IV. Methodological Approaches to Estimating Manpower Requirements

Introduction

Alternative methodologies for estimating requirements are available to the local planner, but no one method is universally applicable and error free. Experience has shown that different methods produce different estimates. A 1970 investigation of six earlier projections of 1975 physician requirements based on different methodologies found that the estimates vary significantly, ranging from 305,000 to 425,000, and that the findings led to opposing conclusions concerning the adequacy of the projected supply of physicians.[1]

All methodologies are tools in the hands of the researcher, and the quality of the product is as much, if not more, a reflection of the skill of the craftsman as of the excellence of the instrument. At every step in preparing an estimate, judgment and assessment are necessary, and no mechanistic technique is a substitute for insight.

In this chapter, we will present the alternative methodological approaches to estimating requirements in a general, conceptual framework. A detailed, step-by-step, how-to-do-it description and an in-depth analysis of the pros and cons of each

1. Hansen, Lee W. "An appraisal of physician manpower projections," *Inquiry*, March 1970.

method are given in Chapter III of Volume II. Most studies are not pure examples of any one methodology but a mix or blend, adapted to the particular circumstances of the area planner. In the social, economic, and political setting in which he operates, the planner pinpoints the specific problem he is addressing and in the light of the resources available to him selects the methodological approach or mix of methodologies best suited to his needs. His alternatives are approaches based on the manpower/population ratio, the service targets, health need, and economic (effective) demand.[2]

The Manpower/ Population Ratio Method

By far the most popular and frequently used methodological approach relates manpower to population.[3] A ratio of the number of health personnel to the total population served is selected. To calculate manpower requirements, the ratio is applied to the target year population.

$$\frac{\text{Manpower}}{\text{Population}} \times \text{target population} = \text{Estimated manpower requirements}$$

The numerator in the ratio, manpower, may refer to discrete occupations (e.g., radiological technologist) or to generic categories (e.g., allied health occupations). The term may be limited to health personnel providing service in a particular setting (e.g., nursing homes) or to a particular type of care (e.g., pediatric), or it may be all-inclusive, encompassing the totality of workers in the health industry.

The denominator of the ratio, population, may be defined in different terms depending upon the

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2. The typology of methodological approaches was adopted from Hall, Thomas L. "Estimating requirements and supply: Where do we stand?" (in) the Pan American Conference on Health Planning, 10-17 September 1973. Washington, D.C.: Pan American Health Organization, Scientific Publication No. 279, 1974.

3. Some researchers invert the ratio, relating population to manpower, e.g., 3,500 population per x-ray technologist.

planner's concerns: total community population if the problem deals with environmental health; citizens 60 years of age and older if the concern is to staff nursing homes and treat chronic illness; the residents of a geographically defined service area if the issue is adequate ambulatory care.

The kingpin of this method is the ratio and its appropriateness. The validity of the estimate depends upon the fit of the ratio. Experts are frequently asked to choose the ratio on the basis of requirements for optimal care or for some minimum standard.[4] Alternatively, planners may adopt the ratio found to prevail in the nation as a whole, or in their region or in a comparable geographic area.

The attributes of the manpower-population ratio method — its simple data requirements, low cost, ease of understanding and application — explain its appeal and popularity. However, one should be aware of its basic limitations. To assume that population size explains manpower requirements ignores important influences that do not operate through population size. Such variables as population density, the organization of the delivery system, the money available to pay for health services, and the productivity of manpower are examples of factors that are overlooked in the ratio method. In using the ratio method, the planner assumes, explicitly or implicitly in the choice of the ratio, that these variables operate in his situation in the same way as in the situation from which the ratio is selected, or that he can make explicit allowances for differences. Despite these caveats, it should be pointed out that other, more sophisticated methodologies may use the manpower-population ratio as an input.

The Service Targets Approach

Recognizing that the relevant measure of manpower requirements is not the number of people but the volume of service, the service targets

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4. The Delphi method may be used to achieve a consensus. It is described in Chapter I of Volume II.

approach focuses on service demands and takes into account the elements of manpower utilization and the organization of the delivery system.

The first step in applying the method is to set the target of the types and quantity of service required by the population in the local area. The constraints of the particular program and of the health delivery system are taken into account in selecting the service goals. For example, let us take the Early and Periodic Screening, Diagnosis and Treatment Program mandated by Congress in 1967 as an amendment to the Social Security Act. Persons under 21 eligible for medical assistance are to be screened periodically and treated for health problems. The program is administered by the states, which, following national guidelines, individually determine the health evaluation procedures to be used and the mechanisms needed to carry out the program. Given these guidelines, the service targets in each state may be determined. If 10,000 children are eligible and screening for health assessment must take place annually, the target is 10,000 visits. However, the decision may be reached to phase the program, taking one-third of the eligibles each year in the light of available resources. Or it may be decided to provide more frequent screening to younger children, less frequent to the older. In that case, the population distribution by age determines the number of visits for the screening target. To set the service target for treatment, one would need information on the incidence of conditions requiring medical treatment that are covered by the program.

With the service targets quantified, manpower requirements are derived by applying factors related to manpower staffing and productivity. Neither of these factors is easily quantified. For purposes of estimating manpower requirements, we would like to know what proportions of the services — the tasks done in a health assessment of a young child, for example — are performed by the pediatrician, the pediatric nurse practitioner, or the practical nurse. Manpower

staffing practices are analyzed by means of task analysis, and this entails a detailed study of job performance in which job functions are identified and separated into tasks. Finally, the worker's activities are studied to pinpoint the tasks he undertakes and the time allotted to each one. The significance of the staffing pattern is that the delegation of tasks — from dentist to dental auxiliary, or from pharmacist to pharmaceutical technician — alters the manpower requirements for each affected occupation.

Productivity (output per unit of manpower) also has a direct and important bearing on the number of workers needed. If one can increase productivity on the average by ten percent, one has in fact proportionately lowered the requirements for personnel. (The unit of output for measurement of health-manpower productivity is a problem still to be resolved.)[5]

To illustrate the methodology of the service targets approach with a simple example, let us suppose that the question the planner needs to answer is, "How many emergency medical technicians (EMT's) are required for adequate service in our community?"

First, we define the service target: say that the number of ambulances required is established as one ambulance per 10,000 people, based on the analysis of the past year's emergency calls and the organization of ambulance services in the area. The service target is validated by the expert judgment of emergency medical physicians. Thus, this community, with a population of 50,000 would require five ambulances.

Second, we determine the staffing pattern: let us assume it is agreed that each ambulance should carry two EMT's, and should be manned 24-hours-a-day, seven-days-a-week.

Third, we decide upon the level of productivity: in this case, the output of emergency personnel is measured by the hours they are available to re-

5. See the discussion in Chapter III.

spond to emergency calls. Each EMT will man the ambulance for an 8-hour day, 40-hour week.

Finally, we calculate the manpower requirements: each ambulance will operate round-the-clock, a 168-hour week. Dividing 168 hours by a 40-hour week for each man equals four men. Multiplying by two men per shift equals eight men, which, when multiplied by five ambulances, equals 40 men. Adding one additional EMT as a relief man gives the community's total manpower requirement for EMT's — 41 men.

The primary focus of the service target approach is on the delivery of care. In estimating manpower, one must consider what types and quantity of service are to be provided to the community and, in turn, the types and amount of service each worker will offer. The planner is led to consider alternative forms of organization and staffing and to recognize that manpower requirements vary with different delivery systems.

Following this approach, however, has its dangers. The planner can easily become bogged down, because a huge volume of data, considerable investment of time and money, and a high degree of statistical expertise may be required to use this method successfully. Another hazard is that the end product, the estimates based on norms or service targets, may not be defensible in terms of economic realities or the felt needs of the community.

The Health Needs Approach

Another methodological approach uses the health status of the local population as the starting point and estimates manpower requirements on the basis of the care needed to attain and maintain good health. A study is made of the health status of various demographic and socioeconomic groups using statistics and professional opinions on morbidity and the proper care for illness and health maintenance. The community's need for health services is translated into manpower requirements.

"Good," being subject to definition, may mean in this context either minimal, adequate or

optimal well-being. The standards of good medical care and the pathways of care are set by professionals — doctors, dentists, therapists, and other medical personnel. They are asked to specify the standard of good care for each service and diagnosis under various health conditions — the nature and content of the care, the number of visits, the time required for each visit, the kinds of personnel delivering the care and so on. For a specific program such as good medical care for children under 17, detailed standards of care are set for well babies, acute and chronic child ailments and other problems. With quantitative information on the size of population, frequency of illness and health conditions, services to be offered and time required to deliver these services, the planner can define the health needs specified by a particular program as a basis for estimating personnel requirements.[6]

A mass of information is needed. On the services side, detailed data are needed on the health conditions of the population and the volume of services estimated to be needed to provide care for specific conditions and health needs. On the manpower side, detailed data are needed on the amount of time it takes to perform the necessary services by each health occupation and on the productivity of each health worker. The health needs approach may be viewed as an extension of the service targets approach in which the targets are set by the biologic needs of the community, as professionally determined.

Let us illustrate the distinctive character of the health needs approach by reverting to the example of an emergency medical technician. The problem is to estimate the number of EMT's needed for ambulance service in a comprehensive emergency medical service system.

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6. Schonfeld, H.K., et al., "The development of standards for the audit and planning of medical care: Good pediatric care program content and method of estimating needed personnel." *American Journal of Public Health.* November 1968.

The health needs are prescribed by the opinions of experts as to the standard of medical care required by the critically injured, heart attack and stroke victims, and other emergency cases. These standards may stipulate that physician and technician services would be available 24-hours-a-day, to provide professional emergency care within 25 minutes of call, for an ambulance trip of no more than one hour within a geographic radius of 50 miles, employing a two-way radio-communication system and hospital-based ambulances. The number of ambulances necessary to meet these standards of need can be calculated by taking into account the community's population characteristics, geography, travel conditions, location of hospital emergency rooms and emergency equipment, and the numbers and types of accidents that require emergency treatment within a certain time period.

The manpower requirements — the number of EMT's needed — are derived in much the same way as in the service target approach: first, the standard of "needed" emergency care must be defined; then the volume of services needed must be quantified. In this particular case, the community is divided into emergency care zones; terrain and road conditions are taken into account in the creation of these zones so that the standards of a 50-mile radius and a maximum trip duration of one hour are met. Within each zone, a study of the number and characteristics of the population and the record of accidents and other emergencies is made to provide a basis for quantifying the emergency care load. The hospitals at which the specially equipped ambulances should be placed are pinpointed. Let us assume that three emergency care zones are designated, requiring a total of five ambulances.

If the manpower components — the staffing pattern and productivity — are envisioned as in the service targets example, we will come up with the same estimate of 41 men. But let us assume that our objective is to meet the community's

minimal needs. We might then alter the staffing pattern to man each ambulance with one driver and one EMT. Our conclusion then would be that the community needs only 21 drivers and 21 EMT's; given the salary differential, this staffing pattern would represent a considerably lower financial burden.

On the other hand, if needs are defined in terms of optimal care, the staffing pattern might be two EMT's per ambulance for each shift, one with a basic 80 hours of training and the second with 360 hours of advanced training — a total requirement of 41 men, as we have already calculated. In addition a back-up emergency medical physician would be required in each zone to guide and direct the personnel in the ambulance. If each doctor works a 50-hour week, each zone would require three and one-third doctors. This would mean a minimum of ten emergency medical physicians for the community.

The main advantage of the health needs approach for the health planner is its logical basis in "what ought to be" as the reference point. This is especially appealing for long-range planning, or high-priority categorical health programs, and for environmental health programs. It could be the proper basis for a health system plan which sets community goals in line with the national guidelines to be established under the National Health Planning and Resources Development Act of 1974.

One disadvantage stems from the difficulty in defining health needs, since expert opinions differ. Moreover, this approach requires detailed disaggregated data and sophisticated computational techniques to quantify needs, services and manpower requirements and therefore is likely to be most costly and time consuming. In addition, the health needs approach, if based upon standards set too high, will over-estimate the manpower that the community is in a position to finance. Policies and programs to supply this level of manpower are likely to result in future unemployment.

The Economic (Effect Demand Approach

This methodological approach focuses on the "effective" demand for health care — the willingness and ability of consumers or the community to pay for health services — as the basic determinant of the demand for manpower. Manpower requirements are derived from an estimate of the monies available from all sources to pay for care, including wages and salaries, or from an estimate of the services consumers are willing to buy, taking into account the tasks performed and the productivity of health personnel. Effective demand for manpower may be elicited from employers or analytically deduced from health expenditures or service utilization data.

To illustrate the distinctive concept that underlies this approach, let us again use the example of the emergency medical technician. It is significant that the problem is now defined as the number of EMT's required to fill the jobs in a community-wide ambulance service.

The initial task is to quantify the effective demand for emergency ambulance services. First, the funds available to operate the service must be determined from a study of the gross revenue generated from emergency calls in the past or from an analysis of the factors that account for the revenue — the number of emergency runs, the distance traveled, fees paid and uncollected charges, government funding support and so on. Information would also be needed on the average cost of operating an ambulance. The number of ambulances the community will support can be determined by dividing the average cost of an ambulance into the funds available.

Alternatively, the effective demand for services might be identified from utilization records, since it can be reasoned that the use of the service indicates the level of consumer demand, representing the need, willingness and ability to buy.

Another approach to measuring economic demand is to go directly to the operators of ambulance services — the hospitals, fire departments, funeral directors, police, or whoever in the

community performs this service — and to ask for their opinions of requirements, present and future. This task produces a direct estimate of manpower requirement, based on employment opportunities, although the employer may himself be deriving the requirements estimate from his judgment of the services demanded or the revenues generated.

The conversion of the demand for ambulances into the demand for EMT's would proceed, as we have described in the service targets approaches, based on data on the staffing patterns and productivity. The computation divides the total amount of services, however defined, by the average output of one health worker.

As we have indicated, a variety of techniques may be used to calculate the economic effective demand and to convert this demand for services into manpower requirements. A survey of employers or an area skill survey is one approach. Another is to analyze empirical evidence of the utilization of services by population groups in relation to measures of disease or illness, personal income and other health system determinants. The most sophisticated techniques employ mathematical models, using regression analysis, mathematical programming and simulation methodologies.

The economic (effective) demand approaches have the advantage of estimating requirements that relate to job opportunities. When the planner's frame of reference is the manpower demanded in the labor market, he properly turns to these methodologies. However, situations exist where service target or health need, not effective demand, is the key determinant, as in assessing the impact of a proposed program in public or environmental health. Moreover, most of the economic demand methodologies require substantial data, technical expertise and financial resources.

Future Requirements

Manpower estimates for present or future requirements may be based on the same method-

ological approaches: health manpower/population rates; service targets; health needs; economic (effective) demand. The time frame, not the technique, produces the distinction between present and future requirements. In calculating future requirements, one incorporates the changes expected or estimated to occur over time. The validity of the requirements projection will reflect the realism of the assumption about the future and the quality of the data that describe the past and the present.

In general, the analytical approach to projections starts with a study of the past or the present, identifying the forces affecting manpower that produce change, and then calculates future requirements based on the impact of these changes over time.

The methodological process underlying all projections may be described briefly as follows: First, one must determine the factors that affect manpower requirements, and study the way in which they have operated. If possible, one should determine any economic variables which measure, are related to, or can serve as a proxy for each factor and which are capable of being projected independently, and study their past relationship to the occupation. Second, one must estimate the future levels of the relevant variables and their future relationship to manpower requirements. Third, the requirements must be projected to the target year on the basis of these relationships.[7]

A brief summary of each method presented earlier in the discussion of present requirements illustrates how each concept is adapted for use in projecting manpower requirement.

1. *Health manpower/population ratios* (ratio method): This method involves the identification of a suitable health manpower/popula-

7. Goldstein, Harold M., "Methods of projecting supply and demand in high level occupations," paper delivered at Annual Convention of the American Statistical Association, Philadelphia, Pennsylvania, September 8, 1965. Washington, D.C.: American Statistical Association, 1965.

tion ratio for a future point in time and then the application of this ratio to the projected population to derive manpower requirements . . . .

2. *Service targets approach* (normative approach): This method emphasizes the development of detailed standards for the provision of different kinds of services, standards which are then used to derive targets for the production of these services. Manpower staffing and productivity standards are then used to convert service targets into the manpower required to attain such standards, including those used in the health needs. [For projection purposes, the targets, manpower staffing and productivity standards are future-oriented.]

3. *Health needs* (or biologic needs): This method seeks to determine, based on expert opinion and taking into account [health status, medical knowledge and] available technology, what kinds, amounts and quality levels of services are required to attain and maintain a healthy population. Service targets are then converted into manpower requirements by means of staffing and productivity standards . . . . [Again, for projection purposes, measures are quantified in accordance with assumptions about the future.]

4. *Economic demand* (or effective economic demand): This method concerns the measurement and projection of what health service people are willing and able to pay for, irrespective of the quality of the specific services obtained or of their need for them . . . . [One variant of] the method consists of correlating the receipt of services with selected economic and other variables, and then of projecting the changes likely to occur regarding these variables in order to derive the impact of these changes on the demand for services and ultimately on health manpower requirements . . . .[8]

Other variants are employer surveys, in which information is obtained on current and expected

8. Hall, Thomas L., *op. cit.*

employment opportunities; and the input-output technique, in which an industry-occupation employment matrix is used, and estimated proportions in specific occupations are applied to the projected total labor force to determine future requirements.

Strengths and Weaknesses of Alternative Methodologies

Manpower requirements are influenced by many economic, political and social factors that interact in a complex fashion we cannot fully measure. Econometric models, attempting to describe the functional relationships among the many variables, use dozens of equations. It is even more difficult to discern and to express in precise terms the dynamic changes which are likely to occur in the future and to measure their impact. The data we do have about the past and present may not be adequate for our needs. In the face of these underlying difficulties, it is not surprising that all of the alternative methodologies are subject to criticism; their strengths, however, should not be overlooked.

The manpower/population ratio method is quick, cheap, easy to do and to understand; unfortunately, it may also be dangerously simplistic, and may use inappropriate ratios that fail to take into account any influence other than population size. The service target approach recognizes — and this is its strength — that manpower requirements are derived from the demand for services, however defined, and that the way manpower is used (the staffing pattern) and how much service each health worker produces (productivity) determine the number of health personnel required. A problem arises when the service targets are set by consumer needs or wants, irrespective of the effective demand for such services. The estimate will most likely overstate the future ability of the market to fund jobs and lead to erroneous policy decisions that could result in unemployment. Another major weakness of the service target approach for projection purposes is its extensive data requirement of variables difficult to quantify

and the real possibility that the planner will become enmeshed in a longer term, more complex, and more costly effort than he realized at the start.

The same criticisms may be directed at the use of the health needs approach for projecting manpower requirements. If the service targets of the future are set according to the standard of "need," the two methodologies converge. The critical step in the health needs approach, that of setting standards for good health care and of establishing the appropriate mode of care for the future, makes the process of projecting requirements even more difficult. Still, the future health needs of the community are the relevant measure in the context of public health and environmental programs.

The economic (effective) demand approach does relate to job opportunities, preventing the overstatement of manpower requirements which may result from other approaches and producing more accurate guidelines for educational planning and vocational counseling. However, none of the specific effective demand approaches is free from technical limitations or problems. For example, the employer survey produces an estimate from the perspective of existing institutions, ignoring new organizations that may come into being and the unstated but assuredly varied assumptions about the future that underlie the responses.

Since each approach has its unique strengths and weaknesses, the planner with sufficient resources may find it to his advantage to make estimates based on several methodologies. He would have at his disposal a range of estimates that would probably prove more useful as a basis for health resources planning than any single estimate would be.

V. Methodological Approaches to Estimating Supply

Current Supply

Measurement of current supply is frequently undertaken in conjunction with the measurement of requirements in order to assess the present situation and to develop a plan that will correct the imbalances. The gap between supply and requirements may be due to a shortage or surplus, but, alternatively, it may be the consequence of maldistribution and poor utilization. In the short run, changes in relative wages, in labor productivity and in worker mobility may bring about an equilibrium without any alteration in the numbers of health personnel. Supply is modified more immediately by geographic and occupational redistribution and greater output per worker through the incentive of increased wages than it is by production of new graduates.

Measurement of the current supply is necessary also for projecting future supply, an essential datum for long-range planning to assure adequate resources to meet the anticipated demand for health care. Educational planning and vocational counseling are guided by supply projections to assure that future graduates will find job opportunities and the economy will have needed workers. An understanding of the factors influencing the supply and the operation of the occupational labor market, especially the demand and

supply elasticities, is vital for formulating effective manpower and educational policies.

Meaningful data on current supply go beyond a head count of the number of persons. For purposes of supply analysis, we should understand the process and structure of supply: how people enter the field; how they acquire the necessary skills; why they leave. Furthermore, we should know the institutional characteristics of the current supply: who the employers are; how jobs are titled; how people are used; how much service they produce; how many hours they work; where they are located; and what they are paid.[1] In addition, the personal characteristics of the current supply — age, sex, education, race, mobility — are also important factors in assessing the state of current supply.[2]

We need to know about the supply structure in order to properly measure the sources of current supply. We need to know the institutional characteristics because the possibilities for adjustments in hiring standards, utilization, productivity, location and salary levels to correct gaps between supply and requirements can be discerned only from a detailed knowledge of existing practices. We need to know personal characteristics to properly assess likely labor force participation. Since women are predominant in many health occupations, the distribution by sex, age and race is a clue to the separation between active and inactive workers in the years ahead. Entry and separation rates are necessary to estimate future supply.

The planner finds that he must function with considerably less information than he ideally

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1. Wages relative to earnings in related occupations and the movement of relative wages are significant indications of supply imbalance.

2. For a more detailed discussion, see U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Supply: Concepts and Sources of Data for Manpower Analysis.* BLS Bulletin 1816. Washington, D.C.: U.S. Government Printing Office, 1974.

would like to have. Time and cost constraints place a limit on the detail with which current supply is measured. The planner is not concerned with occupations whose skill level requires minimal training acquired in short courses or on the job and whose workers easily transfer in and out in response to change in relative wages. The occupations that do concern him are those for which supply is relatively inelastic in the short run because they require substantial education and training and legal and professional qualifications. Forward planning is needed to effect a change in the supply for these occupations. The planner may be especially concerned with occupations for which educational programs exist in his area.

Current supply is defined as the number of active practitioners in the labor force, that is, a count of those employed or actively seeking employment in a health occupation at a given time. Job seekers include the unemployed or new graduates, but they may also be professionals who have been inactive and are seeking to re-enter the labor market. [3] The given time may be the present or a recent year that is used as a baseline or benchmark.

A distinction is made between "active" supply, composed of the number of practitioners presently employed or actively seeking work, and the "potential" supply, consisting of the active workers plus those inactive workers who might be attracted back into the labor force or into the occupation if working conditions or personal circumstances were different. The data concerning inactive workers which is of interest for planning purposes are their personal and professional characteristics and the threshold conditions that would return them to active status. These inactive persons represent a reserve force which may be sizable and which may provide an immediate and least-cost solution to the inadequacy of the current supply.

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3. This is only one of the several definitions of supply that are discussed in Chapter II.

Current Supply Methodologies

Supply methodologies estimate separately the components of supply and add these component estimates to measure total supply. With respect to current supply, these components are the employed and the unemployed. Current supply is often measured in terms of the number employed, ignoring the unemployed (both those between jobs and new graduates actively seeking work) because this group is so difficult to identify. This expedient adjustment in current supply may be justified at times when the rate of unemployment is low. Nevertheless, whenever the unemployed are omitted from this measurement, current supply is underestimated. To measure potential supply, the number of inactive workers is added to the current supply.

Different methodologies may be used to estimate the components of current supply, depending upon the availability of data. Data can be obtained from secondary sources, which have much to recommend them since they provide relatively quick and easy answers. Examples of secondary sources which can provide data useful in estimating current supply are the Bureau of the Census (especially their *Census of Population* and *Current Population Surveys*), the National Center for Health Statistics, the U.S. Bureau of Labor Statistics, state employment security agencies, state departments of higher education, professional associations and trade unions.

However, caution must be exercised in using secondary sources.

> In using estimates of the number of individuals licensed, registered, or certified for a specific category of health personnel as a measure of current supply, the reader is cautioned that adjustments should be made to account for the fact that some of the individuals are employed part-time and some are inactive. In addition, further adjustments should be made on the assumption that not all inactive personnel are equally available for employment. For example, some are re-

tired, disabled, or no longer qualified, while others are only temporarily inactive.[4]

When one gathers supply data from different sources, problems of noncomparability are inevitable and must be resolved by making the most logical linkages and adjustments. The problems the planner will face arise from inconsistent time frames, from different supply concepts, from varying occupational definitions, from different geographical areas, and from gaps in coverage.

Planners should ascertain that secondary sources will not supply usable answers before they embark on the collection of data from primary sources. When it has been determined that it is necessary to collect data at first hand, the planner has two options: (1) an inventory or survey of health care providers; (2) a survey of health professionals.

The employer survey will be useful for the measurement of the employed and the determination of employment settings characteristics; the professional survey will gather data on the active and inactive members and their personal characteristics. Surveys designed to obtain information about the current supply produce data that are relevant for both supply and requirement estimates and for future supply projections.

Future Supply

Future supply estimates must measure the movement of personnel into and out of the current supply (see Fig. 1). The additions or inflows to supply consist largely of graduates from educational and training programs, but they may also be transferees from other occupations or geographic areas or workers re-entering the labor force. The losses or outflows from current supply are caused by death, retirements, and transference to other occupations and other areas.

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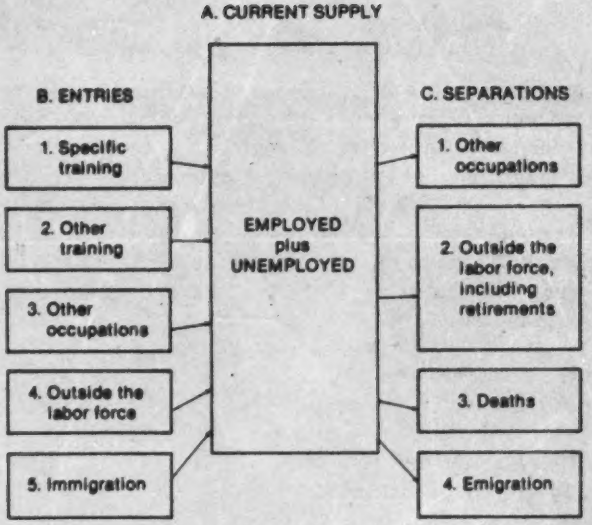
4. U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, *Health Resources Statistics, 1971*, p. 4. Washington, D.C.: U.S. Government Printing Office, February 1972.

Fig. 1. Flows of Workers into and out of an Occupation



Source: U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Supply: Concepts and Sources of Data for Manpower Analysis*, BLS Bulletin 1816. Washington, D.C.: U.S. Government Printing Office, 1974.

To make projections, one must estimate the annual additions and losses during the time period of the projection. In practice the following procedure is usual:

> First, a current supply estimate is established as the base of the projection. Then the annual number of entrants from all sources is developed for the period that the projection is to cover. Third, the base current supply is aggregated with estimates of the annual number of entrants and annual occupational losses are deducted.[5]

However, the lack of data on specific inflows and outflows, e.g., occupational and geographic mobility, leads to modifications in the estimating procedures. Judgments and proxy measures are substituted for specific data.

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5. Rosenthal, Neal, "Projections of manpower supply in a specific occupation." *Monthly Labor Review*, November 1966.

Estimating Inflows

The Production of New Graduates

The annual number of graduates, the major source of additions to the current supply of health professions, is usually available. Data on education enrollment are available from such sources as the U.S. Department of Health, Education, and Welfare and the professional associations. For any particular area, retained graduates are the net addition to the supply; those who move to other locations or other occupations should be excluded from the count of entrants.

To project supply on the basis of future class size, one must allow for student attrition in every year of the program. To make this important correction one analysis proceeded to "adopt the recent attrition experience for schools within an occupation and maintain this rate for the length of the projection period .... The impact upon the supply projections of using alternative estimates of student attrition" was also studied.[6]

One measure of inflows that has a built-in adjustment for student attrition and retention of new graduates is the number of new licentiates. New licentiate data provide a basis for estimating net additions to the stock of supply. It is not a completely accurate measure, for among the annual recipients of a state license are some graduates who, for only one of a variety of reasons, will not practice their profession in the area.

Occupational Transference

Occupations with long and arduous preparation have few dropouts and few transferees. Physicians, for example, typically remain in medicine after graduation, going on to residencies. However, those who elect to go into research, teaching and administration may be considered to be "lost" from patient care. In addition, a few physicians do shift from one medical specialty to another during their working lives.

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6. U.S. Department of Health, Education, and Welfare, Bureau of Health Planning and Resources Development, *The Supply of Health Manpower, 1970 Profiles and Projections to 1990*, p. 9. DHEW Pub. No. (HRA) 75-38. Washington, D.C.: U.S. Government Printing Office, December 1974.

In the health field, credentialing requirements are major barriers to occupational transference. Since licensure laws and certification standards typically stipulate graduation from an approved educational program in the particular occupation as one of the necessary conditions, training or experience in other health occupations is not considered sufficient proof of competence. This obstacle to occupational transference may be lowered or removed by the rise of proficiency and equivalency examinations.

For the measurement of occupational mobility, existing data are unfortunately inadequate. Information on occupational transference (to and from an occupation) may be acquired in a multiphase longitudinal study, in which the same people are interviewed at intervals about their occupation or, as in the 1970 census, in a sample survey in which respondents are asked to recall occupational activities five years earlier. The 1970 census data are being analyzed by the Bureau of Labor Statistics to develop tables showing mobility rates by occupation. When these rates are available, it will be possible to calculate average annual flows due to occupational mobility. Another approach to measurement is the residual method, in which the amount of occupational transference is estimated from historical data on the total supply and on the change in all other inflows and outflows. To use the residual method, the planner must know total supply at two dates and all of the additions and losses to supply within that period of time, other than that due to occupational mobility. The differences between total supply not accounted for by the other flows is attributed to occupational mobility.

Geographic Transference

Movement in and out of the area may also be measured by longitudinal data and may be approximated by the residual method. Geographic and occupational mobility often occur at the same time. Women may move because their husbands' work requires it and may have to take whatever

job is available. Applications for licenses to be granted on the basis of reciprocity or endorsement may be used as a proxy measure of geographic movement between states. In the case of physicians, foreign medical graduates are a major source of additions to supply. Their number is monitored by the American Medical Association and medical licensing boards. Projections of the supply of physicians are strongly influenced by the assumptions as to the level of the flow of foreign medical graduates into the United States.

Re-entrance to the Labor Fo

Women characteristically move in and out of the labor force in response to changes in their family obligations. Female-dominated health occupations, such as nursing and occupational therapy, have substantial reserves of inactive professionals. The age of children and the husband's income are decisive factors in the women's labor force participation. Nationwide labor force participation rates for women are available, derived from working-life tables, but they are not available by occupation. However, the American Nurses Association does collect data on the labor force mobility pattern of RN's, and the nurse's pattern may be a basis for estimates in other women-dominated health occupations. In general, information on reentry for specific occupations is very meager.

Estimating Outflows

Occupation and Geographic Transference

As we have already mentioned, data limitations make it difficult to estimate losses caused by shifts out of an occupation or area. The national office or local affiliates of professional associations may be able to approximate the number of members who have dropped their license or certification. However, many professionals, especially women, retain their credentials even when they have withdrawn from the labor force.

Separations Due to Deaths and Retirements

> [Outflows] from separations can be calculated in several ways. A simple way is to determine the average working life of members of a particular occupation; in an exam-

> ple working life of 40 years, then 1/40 or 2 1/2 percent are assumed on the average to retire or die each year. This percentage would be valid if the numbers at each age level were equal, as in an occupation which has not grown for 40 years and which had a steady influx of workers each year. The rate could be multiplied by the number of workers in the occupation to obtain the actual number who may be expected to leave the occupation each year . . . .
>
> A more refined technique for estimating deaths and retirements is based on "tables of working life." These tables are statistical or actuarial devices for summarizing the mortality experience of the population at some particular period of time, i.e., the death rates, by age, over a one-year period. A life table starts with a hypothetical group of persons — usually 100,000 born alive — and follows the death rates of the real population at each age. Tables of working life also indicate labor force participation of the initial group of 100,000 from 16 years of age; it shows attrition caused by withdrawals from the labor force as well as by mortality. Tables of working life, which have been set up on an actuarial basis for both men and women, account for deaths and retirements (separately) at each age level.[7]

The Bureau of Labor Statistics recently issued a bulletin, entitled "Estimating Occupational Separations From the Labor Forces for States," designed to aid state manpower analysts in estimating occupational separations from the labor force. Individual state labor force separation rates are covered for 1970 and 1985 for over 420 occupations.

Strengths and Weaknesses of Supply Methodologies

Supply methodologies vary with the concept of supply and with the component of supply being

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7. U.S. Department of Labor, Bureau of Labor Statistics, *Tomorrow's Manpower Needs: Estimating Occupational Separations From the Labor Force for States*, Supplement No. 4. Report prepared by McElroy, Michael P. and Cangialosi, Joseph S. Washington, D.C.: U.S. Government Printing Office, 1974.

measured. The strengths and weaknesses of supply methodologies reflect the availability, comparability, consistency and validity of the data used, as well as the number of components of inflows and outflows included in the supply estimate.

Active supply turns to employment records; potential supply must also measure inactive workers and therefore seeks information from individual practitioners and professional associations. Current supply methodologies are designed to collect necessary data or to adapt available secondary data from different sources.

Future supply methodologies estimate specific additions and losses to supply during the projection period. To quantify the various inflows and outflows from the stock of supply, data are collected or secondary sources and proxy data are analyzed by a variety of statistical methods. Census and sample surveys, trend analysis and simple statistical measures are widely used; thus, supply methodologies incorporate the strong and weak points of these techniques.

In general, data for the independent health professions — physicians (MD's and DO's), dentists, optometrists, pharmacists, podiatrists, veterinarians, registered nurses and credentialed allied health occupations, such as dental hygienists and dietitians — are much more readily available and of better quality than for most allied health and public health occupations. Similarly, estimates of some elements of future supply are better than others; for example, the inflow of graduates is better reported than the outflow due to geographic or occupational mobility.

One of the strengths of supply methodologies is that, in general, data are available for the major inputs; those elements for which information is deficient are by and large relatively small. For example, estimates of current supply typically ignore the unemployed, and estimates of future supply frequently do not take into account occupational mobility. These "omissions" do not seri-

ously affect the final supply estimates since they are of small account in most places, at most times and for most health occupations.

The weaknesses of supply methodologies are significant. First, they produce a head count overlooking the importance of the mix of manpower and the quantity of services supplied. It does not follow automatically that a larger number of persons will provide more services, or the converse, that a smaller number of personnel will reduce the quantity of services. Labor productivity and the organization of the delivery system affect the supply of services that health workers provide, but supply methodologies ignore these effects. Moreover, even when the head count is of full-time equivalent personnel, the estimate may be misleading if it is based, not on the number of hours worked, but on some arbitrary assumption that two part-time workers equal one full-time worker. Furthermore, the head count does not sufficiently describe the workers by such characteristics as age, sex, race, mobility, educational attainment, to enable the planner to logically evaluate the estimates of supply.

Second, the methodological approaches estimate the supply of labor independent of the demand for labor. As we have discussed earlier, the amount of supply — the number of health workers — is responsive to changes in the labor market, such as relative wages or working conditions. An obvious example is the number of inactive nurses who would return to active participation in the labor force if wages became sufficiently attractive, or if part-time work or flexible hours could be arranged.

Third, several methodological approaches have inherent weaknesses, which are discussed in Chapter IV, Vol. II. The estimate of additions to supply, for example, may be based on the output of educational programs, new graduates, or the annual addition to licensed practitioners. If the figures of new graduates or new licentiates are used without adjustment, the attrition due to geo-

graphic mobility, occupational transference, or labor force withdrawal is ignored.

All supply methodologies have inherent strengths and weaknesses. The planner must recognize the qualities of the methodology he is using, adjust the estimate to the best of his ability to take into account the likely error, and use his final estimate with a full awareness of the implications of the estimating process.

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VI. Health Manpower Issues: Uses and Limitations of Statistics

Introduction

Manpower statistics are a basic element in area health planning. One writer, who sees more adequate statistics as a key element in the solution of manpower problems, has characterized the manifold uses of these statistics as:

1. assessing present and prospective health manpower supply relative to demand or requirements;

2. formulating goals for recruitment, training, and alternative uses of health manpower;

3. appraising the feasibility of implementing specific pieces of health legislation;

4. health manpower planning on the regional, state and local levels with respect to inequality of access to health care services; and

5. health manpower research, such as the diagnosis of shortages, productivity studies, the impact of new technology, and the like.[1]

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1. For an insightful discussion of the uses and limitations of current manpower data, see Butter, Irene, "Improved statistics are required." *Hospitals*, July 1, 1972.

From another perspective, the President's Committee on Manpower pointed to several specific purposes which manpower projections might serve, such as:

> To alert government (and other interested parties) to emerging manpower problems; commonly, an imbalance between the demand for and supply of workers in the labor force.
>
> To help choose between alternative proposed policies.
>
> To assist in administering specific government programs.
>
> To provide an essential element for developing other general types of projections by government and private organizations. [2]

Thus, manpower statistics are the raw materials of planning, necessary inputs to the development of educational and training programs and to vocational counseling. Appropriately analyzed, they help the planner to probe the constraints to increased supply and to identify the proper focus of recruitment and retention efforts. They affect his evaluation of the feasibility of new health policies and programs and of the likelihood of achieving certain standards of health care. Manpower data influence his recommendations on proposed new and expanded health care facilities as well as on new educational institutions. In this way, the planner becomes one of the forces working to align health manpower resources with health care demands and needs.

Problems in Data Gathering

Area health planners find they must have answers to a multitude of questions related to manpower supply and requirements: What types of personnel are needed? What educational and training programs are being offered now — what kinds of occupations are being trained; where are

2. U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Manpower and Training Needs: Information for Planning Training Programs for the 1970's.* BLS Bulletin 1701. Washington, D.C.: U.S. Government Printing Office, 1971.

the programs located; how many students are graduated; where do they find work? What other sources of supply exist in the area? How will manpower requirements change over time? What will happen to demand in the future, if, for example, National Health Insurance becomes law? How will it affect personnel requirements in the area? Will the present supply sources be adequate for the community's needs in the future? What changes should be made?

The health planner must cope with a number of problems in measuring local supply and requirements. First, accurate estimates must be developed from an analysis of the detailed characteristics of the population and its demand for health care; of the organization of the health delivery system and the pattern of health manpower staffing and utilization; of the inflows and outflows of sources of supply and the functioning of the labor market. However, with regard to each field of analysis, area statistics (and in many instances, national data) are limited; for example, area data on health care needs, services used, medical expenditures, labor productivity, the personal characteristics of workers and their relative wages are seldom available. Not only are current data lacking, but reliable information about the past may not exist and that which is available may not be consistent or comparable over time because of different definitions, coverage, time spans and data collection methods. Moreover, the sources of information may be misleading; for example, certification registries and licensure records overstate the supply by including professionals not in the labor force but omit employed practitioners who are not credentialed. The data problem is magnified by the proliferation of health occupations and titles — numbering in the hundreds — with the same job title at times used to describe different sets of functions and responsibilities. To compound the problem, disaggregated data for relevant labor market and health service areas are woefully inadequate: most manpower data have

been collected at the state and national levels. While some relevant statistics are available for the county and standard metropolitan statistical area (SMSA), small area estimates and projections of essential information are notably missing.

Second, no simple guideline or consensus exists to aid in the identification of appropriate methodologies. The lack of agreement reflects the general lack of knowledge about the forces influencing the demand for health care, about the conversion of that demand into manpower requirements, and about the supply responses to changing circumstances. It also reflects differing opinions about concepts and definitions. Even when there is agreement on factors that must be measured, we are not certain how best to proceed. For example, we know that head counts by discrete occupations are misleading; that the health professions function in a complex web of complementarity and substitutability. But we do not have operationally practical techniques to measure the manpower input in health teams or other staffing patterns. We have no accepted method for measuring the output of health workers. In other words, we have no input and output measures to translate manpower demand and supply into the demand and supply of services, and vice versa.

Third, projecting local conditions into the future is hazardous. Future requirements for manpower in the health service industry will be influenced by policies and programs (e.g., the introduction of a National Health Insurance plan and the spread of health maintenance organizations) the impacts of which can only be dimly seen. Similarly, the supply of manpower will be influenced by new efforts, such as the direction of Federal support for health manpower training and education and the increased labor force participation of women. In addition to forces of national significance, the local planner must take into account specific local factors and their effect upon health manpower in the future. Moreover, the adequacy of the future supply in relation to future demand

for health manpower will depend in large part on geographic and specialty distribution, subjects about which there is limited understanding and information.[3]

Distribution of Health Manpower

The maldistribution of health manpower has been identified as one of the key issues the health planner must address in the 1970's. This problem was not apparent in the 1960's when the number and variety of paramedical personnel proliferated and shortages were prevalent. It is estimated that at least 1,000 communities in the United States are without adequate health care. Areas of scarcity suffering from maldistribution of personnel refer not only to geographic areas but also to minority populations, to types of physicians, and to types of services. Today the inadequacy of health care and the short supply of health workers are especially evident in outlying rural areas and in the inner-city slums. Of special concern is the declining proportion of physicians providing primary care, indicative of the maldistribution among medical specialties.

Health planners rely heavily on the manpower/population ratio method for identifying areas of scarcity. It is a gross measurement, generally of the number of physicians, nurses, pharmacists, etc., per 100,000 population, that does not explicitly take into account the determinant factors other than changing age composition and urbanization. Besides ignoring causative relationships, this approach to studying maldistribution presents the problem of deciding what should appropriately go into the numerator and what into the denominator, and what is the proper ratio to use as a standard. However, when area population figures and supply data are available, a compari-

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3. U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, *Factors Influencing Practice Location of Professional Health Manpower: A Review of Literature*. DHEW Pub. No. (HRA) 75-3. Rockville, Md.: U.S. Department of Health, Education, and Welfare, 1974.

son of the ratios in various areas does distinguish the poorly served relative either to other areas or to some standard of a well-served community, although it does not explain the differences or point to possible remedial actions. [4]

Moreover, maldistribution is a problem that may not be capable of resolution at the local level. It is not within the local planner's ability, for example, to change the immigration laws to increase or decrease the number of foreign medical graduates in his area, nor can he change the environment of the area to make it more attractive for doctors and their wives. [5] Doctors operate in a national labor market; they have freedom to choose where in the United States they will practice. The planner can, however, locate the underserved area, pinpoint the skills in short supply, identify the constraints on supply that must be lowered or removed, and explain the policy options available to his community in its attempt to cope with the problem. An accurate diagnosis of the nature of the maldistribution and the proper prescription of effective remedies are the responsibilities of the planner.

Effective Manpower Utilization

Effective manpower utilization, another critical issue, may be the answer to maldistribution in some areas. In fact, some authorities believe the maldistribution problem is in reality a malutilization problem. Concern with the utilization of man-

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4. See the discussion of the use of population ratios for purposes of analysis in U.S. Department of Health, Education and Welfare, Bureau of Health Resources Development, *Distribution of Medical Specialty Manpower*, BHRD/RAS Report No. 74-192. Bethesda, Md.: U.S. Department of Health, Education, and Welfare, April 26, 1974, p. 27.

5. See U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, *Factors Influencing Practice Location of Professional Health Manpower: A Review of Literature*, DHEW Pub. No. (HRA) 75-3. Rockville, Md. : U.S. Department of Health, Education, and Welfare, 1974.

power is associated also with efforts to improve the quality of care and to control medical costs.[6]

Just as demand for health services manpower is derived from the demand for health services, it is possible to think of supply of manpower in terms of the health services that can be provided by a given pool of manpower utilized with reasonable efficiency. This is another way of saying that the approach to problems of supply is through productivity (output of services per unit of manpower). This places the emphasis not on tables of organization but on the most economical way to provide the specified level and quality of service. One way is through substitution of equipment for additional manpower: Given the costs of manpower and equipment, is it economical to use an autoanalyzer instead of additional laboratory personnel? Another approach is through task delegation, to economize on the use of the scarcer, more costly manpower by delegating less exacting tasks to less costly personnel as far as is consistent with good medical practice, thus increasing the effective supply of services that can be provided by the more expensive types. Such utilization requires a higher order of health resources planning and better management than is generally practiced in the health services sector. (In fact, it may require an expansion of the supply of trained health services management personnel.)

Techniques of job analysis are being developed. The concept of realignment of tasks to create more effective task clusters and more rational occupational roles in a "medical team" is being implemented. The complementary nature of occupations and the most efficient assignment of

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6. See U.S. Department of Health, Education, and Welfare, National Center for Health Services, Research and Development, *The Utilization of Health Services: Indices and Correlates, A Research Bibliography*, DHEW Pub. No. (HMS) 73-3003 (Rockville, Md.: U.S. Department of Health, Education, and Welfare, 1972).

work among a group of health workers are stressed in effective utilization. The functioning of the operating room team is an example of complementarity; the use of physicians' assistants in an illustration of substitutability. The possibilities of substituting more readily available or lower cost health workers for scarce and expensive professionals have implications for the quantity, quality and cost of care, as well as for manpower planning.

Productivity: The "Physician Extenders"

The transfer of functions from professional to paraprofessional — task delegation — is one of the major mechanisms for increasing the supply of medical services. In the last few years a spate of new occupations, collectively called "physician extenders," has emerged under such titles as physician assistant, Medex, child health associate, clinical associate, nurse practitioner, Primex, aimed at coping with the doctor shortage in primary care and in underserved geographic areas.

The complementary nature of occupational roles and the possibilities for substitution add an additional important dimension to estimating supply and requirements. Estimates of discrete occupations, measured without regard to their relationship to other professions, overlook the possibilities for increasing productivity and thus reducing manpower requirements and increasing effective manpower supply.

Basic to the development of the physician assistant as a new health occupation, for example, is the assumption that the assistants will increase the productivity of the physician and that together the doctor and his assistant will deliver a significantly higher quantity of medical care, with no sacrifice of quality. No estimate of future requirements or supply of physicians can ignore the role of the physician assistant and his impact on physician productivity. Unfortunately, the analysis of labor productivity in the health care sector has proved to be one of the more difficult tasks undertaken by researchers in this field. The cause of

this difficulty is the uncertainty underlying the specification and measure of the "output" of medical personnel. In recent years two distinct approaches have developed toward what physicians and other health manpower actually "produce." One approach defines service output as the total health profile of the consumers of such services. To this end researchers have used mortality and morbidity rates. The other approach considers that "inputs" to maintaining the health of a population (e.g., visits to the doctor, patient-days in hospital, or specific detailed health service activities) are actually the output of health service personnel.

What gain in physician productivity occurs when he uses assistants? One study concluded that:

> The average American physician could profitably employ roughly twice the number of aides he currently employs and thus increase his hourly rate of output by about 25 percent above its current level. This figure takes on added meaning when it is recalled that a mere increase of four percent in average physician productivity in the United States would add more to the aggregate supply of medical services than would the entire current graduating class from American medical schools.[7]

The estimation of the supply of services available from a given manpower supply requires explicit specification as to the delivery system for health care in the area. A given number of physicians, nurses, and technicians will supply one quantity and mix of services through a delivery system based on physicians in solo practice; and a quite different one through a system based on clinics, HMO's and hospital outpatient services. Even if the quality of care is assumed to be the same, there are differences in the utilization and productivity of manpower, as well as of capital.

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7. See PL 92-603, sec. 241, entitled "Program for Determining Qualifications for Certain Health Care Personnel."

In the determination of manpower requirements and in the evaluation of manpower supply, productivity is too important a consideration to be ignored. Faced by a lack of data, the health planner must rely on his best judgment to develop reasonable assumptions in his projections.

Qualification of Manpower

Existing credentialing practices have been identified as a major obstacle to increasing productivity in the health occupations. One criticism of present credentialing practices is that they prescribe qualifications beyond those required for satisfactory and reliable performance, thus artificially constraining the supply of manpower and the efficient organization and operation of medical delivery systems. Still another criticism is that credentialing today constrains the development of new occupations. For example, the functions of the family nurse practitioner and the pediatric nurse practitioner may involve functions restricted by law to the physician. Many doctors are deterred from delegating duties to subordinates because of the legal limitations on their scope of practice. The Federal Government has acted to lower the credentialing barriers by supporting the development of equivalency tests to permit persons with knowledge acquired on the job or through nonacademic routes to challenge course requirements and receive advanced standing, and thus reduce the time needed to achieve academic credentials. The Government is also funding the development of proficiency examinations, enabling persons who have acquired their skills through nontraditional routes to demonstrate their ability to do the work and thus be credentialed. [8] The area health planner may attack the credentialing constraints on supply by working to change licensing laws and by encouraging employers to reassess their hiring standards and to use equivalency and proficiency examinations.

8. *Ibid.*

Technological Innovation and New Modes of Delivery

Productivity increases may stem from technological advances as well as from the realignment of tasks. In fact, these two forces often go hand in hand. The revolution in the medical laboratory, for example, has been wrought by automatic equipment and computers in the hands of such specialized personnel as cytotechnologists and hematologists. The extraordinary rise in the number of laboratory tests performed has only been possible through the downward transfer of functions from the pathologist to the medical laboratory technologist to the technician to the aide. Until recently, it was feared that an inadequate supply of laboratory personnel would limit the potential contribution of pathology to medical care. Similarly, the revolution in communications technology has made possible the great advances in emergency medical services by enabling allied health personnel, such as emergency medical technicians and physician assistants, to function under the supervision of a physician, although physically remote. Designers of communication satellites envision their use for medical consultations to remote areas via two-way, color, satellite transmission.

Technological improvements impact on requirements as well as on supply. In the recent past, we have experienced, in part as a result of technological and biomedical advances, an explosion of expectations which have increased the demand for health services and compelled changes in the delivery system. New patterns of care brought about by technology and research call for new concepts in health personnel; new occupations and changes in existing occupations through increased specialization are probably the most direct manpower effect of technological advances. [9]

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9. U.S. Department of Health, Education, and Welfare, *Technology and Health Care Systems in the 1980's*. DHEW Pub. No. (HSM) 73-3016. Washington, D.C.: U.S. Government Printing Office, 1972.

Projections of future supply and requirements cannot ignore the inevitable changes that will occur in health care demands and manpower productivity due to new technology. Assumptions with regard to its impact should be formulated; a set of assumptions — high, medium, low impacts — would provide more useful guidelines than a point estimate.

In recent decades, new modes of delivery have emerged in the face of rising demands and rising costs. The most talked about is the health maintenance organization, which, through economies of organization and scale, both encourages and facilitates combinations of medical and allied health personnel not feasible in the typical doctor's office; for example, the use of nurse practitioners acting, under the supervision of physicians, as primary care providers in an HMO clinic.[10] Similarly hospital delivery systems are being modified in ways that alter staffing patterns and open new potentials for paramedical personnel. Outpatient departments and emergency rooms are being restructured and reorganized as primary providers. These modes of delivery lend themselves to team approaches with consequent opportunities for increased use of allied health personnel. The health planner must be cognizant of the changing pattern of health delivery and manpower utilization evolving in his area and must estimate manpower requirements for that developing system with its staffing patterns.

One study of the impact of HMO's on future manpower requirements found that fewer physicians and nurses, but more eye-care workers, dentists, health administrators and some allied

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10. U.S. Department of Health, Education, and Welfare, National Institutes of Health, *HMO's . . . Their Potential Impact on Health Manpower Requirements*, prepared by Swift, John L., Montalvo, Ramiro A. and Ward, John R. GEOMET Report No. HF-239. Washington, D.C.: U.S. Government Printing Office, 1973.

health workers, would be needed. [11] The methodological approach was a constant utilization rate with a changing population model. Briefly, the steps followed were:

1. Manpower requirements were estimated separately for two types of HMO's — group practice HMO's and individual practice HMO's — and for all other organizations.

2. It was assumed that future manpower requirements in all segments were a function of how manpower is used (staff utilization ratio) and the total health care services demanded in the future.

3. The staff utilization ratio in HMO's is the ratio of the base-year manpower requirements and the base-year number of patient visits (visits per unit of manpower), information obtained from a sample of existing HMO's.

4. The manpower requirements for HMO's were derived directly, and all other manpower requirements were derived by the residual method.

5. Three scenarios were assumed, based on the level of Federal involvement in the spread of HMO's — minimal, moderate and substantial. Enrollment growth is estimated at each level of Federal support and is applied to the data on utilization rates obtained from a sample of existing HMO's to project the future level of patient visits.

6. The staff utilization ratio is applied to the future level of patient visits to estimate future manpower requirements of HMO's.

All health planners must take cognizance of the impact of the National Health Insurance program that appears certain to be enacted in some form in the next few years. The lowering of the financial barriers to care will inevitably shift the demand for medical services and the demand for manpower upward, but not necessarily equally across the board. The differential impact on services and on manpower will reflect the coverage, beneficiary

11. *Ibid.*

contributions, and provider reimbursement formulas that are adopted, on the one hand, and the price elasticity of demand, on the other. In the face of the uncertainties of the kind of National Health Insurance program that will finally emerge and of the changes in utilization as consumers react to lowered medical prices, the conceptual problems the planner faces in adjusting his manpower estimates for the impact of National Health Insurance are very great. However, one study of the impact of National Health Insurance on future health manpower requirements applied an effective demand methodological approach, assuming constant utilization rates and changing population and income.[12] Three different demand models were structured. Several types of demand curves, alternative national health plans, and several levels of price elasticity were assumed. Changes in the utilization rate without National Health Insurance and with the archetypal health insurance plans were determined. Demand shift factors were calculated and applied to target-year manpower requirements, in order to estimate the impact of the alternative health insurance schemes on manpower. The study found that there is no conceivable, practical way to produce the number of physicians required by the likely expanded demand for health services if present manpower utilization patterns continue to be followed.

The new manpower issues that need to be addressed in the 1970's — maldistribution, utilization, National Health Insurance, and so on — add urgency to the health planner's task. The importance of accurate and timely area statistics on health manpower supply and requirements is

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12. U.S. Department of Health, Education, and Welfare, Bureau of Health Resources Development, *Assessment and Evaluation of Archetypal National Health Insurance Plans on U.S. Health Manpower Requirements*, prepared by Huang, Lien-fu, and Shomo, Elwood W. (Robert R. Nathan Associates, Inc.). DHEW Pub. No. (HRA) 75-1. Rockville, Md.: U.S. Department of Health, Education, and Welfare, 1974.

underscored by Public Law 93-641, the National Health Planning and Resources Development Act of 1974. It provides that national guidelines "reflecting the appropriate supply distribution and organization of health resources"[13] be set by 1976. Health planners will need to quantify the manpower supply and requirements of their area in order to establish local priorities in accordance with the national guidelines and to resolve the demand-supply imbalances that exist or are developing.

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13. P.L. 93-641, Sec. 1501 (b) (1).

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